CLAIMS

1. A semiconductor device which comprises:

an N-type semiconductor substrate including arsenic as an impurity and having a ground surface formed on one surface thereof, said ground surface having concavo-convex irregularities;

a first electrode formed on another surface other than said one surface of said N-type semiconductor substrate;

a second electrode formed on said ground surface and ohmically-contacted with said N-type semiconductor substrate through said ground surface; and

a semiconductor element formed in said N-type semiconductor substrate and in which an electric current flows between said first electrode and said second electrode during an ON-state thereof.

2. A semiconductor device according to claim 1, wherein said N-type semiconductor substrate is a silicon substrate.

3. A semiconductor device according to claim 2, wherein a concentration of said arsenic is in a range between 7×10^{18}-$1 \times 10^{21} cm^{-3}$.

4. A semiconductor device according to claim 3, wherein a resistivity of said N-type semiconductor substrate is less than $0.008 \Omega \cdot cm$.

5. A semiconductor device according to claim 1, wherein a thickness from a surface of said first electrode to a surface of said ground surface is 200-450μm.

6. A semiconductor device according to claim 1, wherein said semiconductor element is a MOSFET, said first electrode is a source electrode of said MOSFET, and said second electrode is a drain electrode of said MOSFET.

7. A method of manufacturing a semiconductor device, which comprises the steps of:

(a) preparing an N-type semiconductor substrate including arsenic as an impurity and having a predetermined thickness;

(b) forming a semiconductor element in said N-type semiconductor substrate, said semiconductor element flowing an electric current in a direction of said thickness of said N-type semiconductor substrate, said step (b) including a step of forming a first electrode on one surface of said N-type semiconductor substrate;

(c) after said step (b), grinding another surface other than said one surface of said N-type semiconductor substrate to reduce said thickness and to form a ground surface on said another surface of said N-type semiconductor substrate which has concavo-convex irregularities; and

(d) after said step (c), forming a second electrode on said ground surface so that said second electrode is ohmically-contacted with said N-type semiconductor substrate.

8. A method of manufacturing a semiconductor device according to claim 7, comprising the further step of using said semiconductor device in a motor vehicle.

9. A method of manufacturing a semiconductor device according to claim 7, wherein said step (a) is a step of preparing a silicon substrate.

10. A method of manufacturing a semiconductor device according to claim 9, wherein said step (a) is a step of preparing an N-type semiconductor substrate including an arsenic concentration of which is in a range between 7×10^{18}-$1 \times 10^{21} cm^{-3}$.

11. A method of manufacturing a semiconductor device according to claim 10, wherein said step (a) is a step of preparing an N-type semiconductor substrate resistivity of which is less than $0.008 \Omega \cdot cm$.

12. A method of manufacturing a semiconductor device according to claim 7, wherein said step (c) is a step of grinding said another surface of said N-type semiconductor

substrate until a thickness from a surface of said first electrode to said ground surface is 200-450μm.

13. A method of manufacturing a semiconductor device according to claim 7, wherein said step (b) is a step of forming a MOSFET in said N-type semiconductor, said first electrode being a source electrode of said MOSFET, and said step (d) is a step of forming a second electrode which is a drain electrode of said MOSFET.

14. A method of manufacturing a semiconductor device according to claim 7, wherein said step (c) is a step of grinding said another surface of said N-type semiconductor substrate by a surface grinding process.

15. A method of manufacturing a semiconductor device according to claim 14, wherein said step (c) is a step of surface grinding said another surface of said N-type semiconductor substrate by using a grindstone granularity of which is between No. 300-No. 500.

16. A method of manufacturing a semiconductor device, which comprises the steps of:

(a) preparing an N-type semiconductor substrate;

(b) forming a semiconductor element in said N-type semiconductor substrate, said semiconductor element flowing an electric current in a direction of a thickness of said

N-type semiconductor substrate, said step (b) including a step of forming a first electrode on one surface of said N-type semiconductor substrate;

(c) after said step (b), grinding another surface other than said one surface of said N-type semiconductor substrate to reduce said thickness and to form a ground surface on said another surface of said N-type semiconductor substrate which has concavo-convex irregularities, a thickness from a surface of said first electrode to said ground surface being 200-450μm; and

(d) after said step (c), forming a second electrode on said ground surface so that said second electrode is ohmically-contacting with said N-type semiconductor substrate.

17. A method of manufacturing a semiconductor device according to claim 16, wherein said semiconductor device is a device for a motor vehicle.

18. A method of manufacturing a semiconductor device according to claim 16, wherein said step (a) is a step of preparing a silicon substrate.

19. A method of manufacturing a semiconductor device according to claim 18, wherein said step (a) is a step of preparing an N-type silicon substrate including an arsenic

concentration of which is in a range between 7×10^{18}-$1 \times 10^{21} cm^{-3}$.

20. A method of manufacturing a semiconductor device according to claim 19, wherein said step (a) is a step of preparing said N-type silicon substrate to have a resistivity of which is less than $0.008 \Omega \cdot cm$.

21. A method of manufacturing a semiconductor devie according to claim 16, wherein said step (c) is a step of grinding said another surface of said N-type semiconductor substrate by a surface grinding process.

22. A method of manufacturing a semiconductor device according to claim 21, wherein said step (c) is a step of surface grinding said another surface of said N-type semiconductor substrate by using a grindstone granularity of which is between No. 300 - No. 500.

23. A semiconductor device for a motor vehicle which is demanded with a withstanding voltage of 50-60V, which comprises:

an N-type semiconductor substrate including arsenic as an impurity and having a ground surface formed on one surface thereof, said ground surface having concavo-convex irregularities;

a first electrode formed on another surface other than said one surface of said N-type semiconductor substrate;

a second electrode formed on said ground surface and ohmically-contacted with said N-type semiconductor substrate through said ground surface; and

a semiconductor element formed in said N-type semiconductor substrate and in which an electric current flows between said first electrode and said second electrode during an ON-state thereof.